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Vision 21 The "Ultimate" Energy Complex

"Can you develop the ultimate energy facility—not simply the next generation facility, but the ultimate facility? And not just the ultimate power facility, but the ultimate energy facility—where every usable Btu in coal or biomass, or perhaps a fuel mix, is extracted and used for electricity and process heat, fuels, chemicals or combinations?"

That was the challenge issued to the coal research and development (R&D) community by George Rudins, Deputy Assistant Secretary, Coal and Power Systems, in the U.S. Department of Energy (DOE) Office of Fossil Energy. The result: Vision 21.

DOE has devised an R&D roadmap known as Vision 21, a technology laden avenue seeking to provide the United States with a host of energy products—not electricity alone—by 2015. More specifically, Vision 21 refers to a fleet of advanced, ultra-clean,

highly efficient power plants capable of producing several energy products: electricity and steam, as well as premium chemicals and feedstocks, and clean liquid fuels. Virtually every energy-using sector—residential, commercial, industrial, transportation—would benefit. These plants, appropriately enough, are called EnergyPlexes.

FETC Technologies Figure in Vision 21

Several technologies now in the R&D pipeline at the DOE's Federal Energy Technology Center (FETC) are to be incorporated in



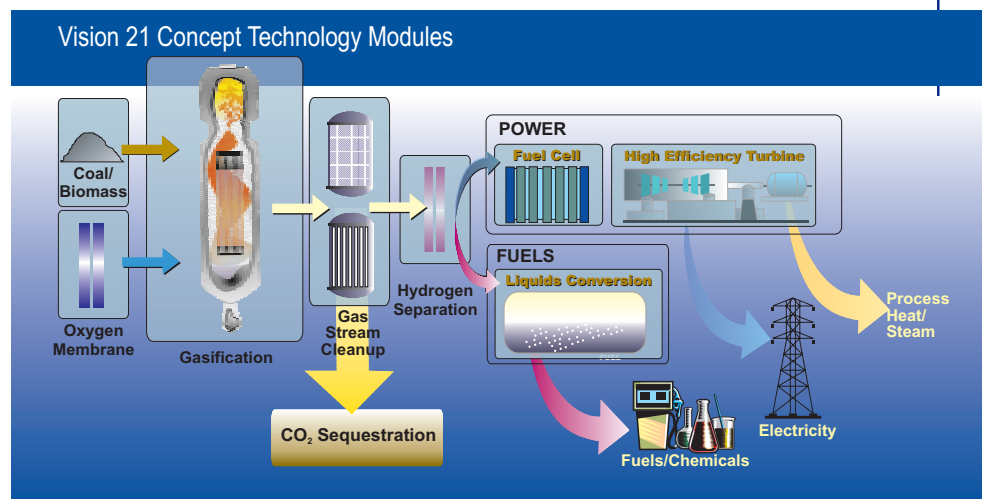
Artist's conception of a Vision 21 EnergyPlex, the crown jewel of FETC's fossil energy research and development.

Vision 21 EnergyPlexes. Advanced turbines, fuel cells, indirectly fired cycles, and integrated gasification combined-cycle (IGCC) systems, all FETC-managed products, form the nucleus of Vision 21, a culmination of today's cutting-edge technologies created through partnerships between FETC and private companies. Each system emphasizes high efficiency, low emissions, and little CO₂ output—a Vision 21 maxim.

“Vision 21 is not so much a ‘new start’ as it is a new way of thinking about our existing technologies...” summarizes Mr. Rudins, “and working to tie them together in the most flexible, efficient way in the future.”

Because plant efficiencies in a Vision 21 configuration would reach and eventually exceed 60 percent when coal is the feedstock and 75 percent when using natural gas, less fuel would be required. A flexible design ensures that some Vision 21 units could be equipped with a CO₂-capture device, an option that would make them virtual “zero discharge” plants. A 60-percent efficiency rating represents marked improvement over today's most efficient coal plants, which strive to reach 40 percent, and extremely efficient natural gas units, which can top out at 58 percent. Combining high efficiency with CO₂ sequestration, Vision 21 plants would effectively address climate change concerns while ensuring that fossil fuels, especially coal, remain an important part of our energy supply.

In addition, Vision 21 plants, projected to be built across the nation, would be able to operate on several fuels: coal, natural gas, and, in time, combinations of fossil fuels with biomass or



municipal solid waste. Such a feature would help ensure that our land and waterways, along with air, remain clean.

Technology Goals

The primary goal of Vision 21 is to develop a set of advanced technology modules that can be integrated and configured to create the EnergyPlexes, which, in turn, are tailored to specific energy markets of the future. These interchangeable modules are to provide Vision 21 plants with flexibility.

In a Vision 21 setting, advanced turbines, gasifiers, high-temperature combustion systems, or fuel cells would be used in modular form to generate power. Early versions of these technologies are beginning to enter the commercial market. DOE-funded research will accelerate advancements. Ultimately, these systems could be fine-tuned for Vision 21 applications.

Because EnergyPlexes could be customized, they could better respond to specific needs of local markets. For example, an EnergyPlex may be equipped to produce electricity along with low cost fuels and chemicals near areas with several chemical-processing

companies. Another EnergyPlex may be tailored to coproduce low priced feedstocks in regions where there is a market demand for them.

How a Vision 21 EnergyPlex Could Operate

- A gasifier burns fuel and sends the gas to one or more modules that use the gas for specific purposes.
- One module would rid the gas of pollutants and particulate matter and then would channel it to a fuel cell module, which generates electricity.
- Fuel cell exhaust would be used to drive a turbine that produces power.
- A portion of the cleaned gas could be siphoned off and funneled to a synthesis gas module that yields fuels and chemicals.
- Another module also could be added to capture CO₂ and pump it into the ground or store it for other uses.

Business Strategies


While feedstock coproduction won't be available for several years, we won't have to wait long for other Vision 21 benefits. Some may be realized as early as next year with the advancement and progress of several DOE-sponsored technologies, including those stemming from the Clean Coal Technology (CCT) Program, that are to play a role in Vision 21 EnergyPlexes. Indeed, several CCT projects like IGCC systems are now demonstrating that clean, affordable electricity can be generated from coal plants.

As technologies such as fuels cells, which use an electrochemical process to generate electricity somewhat like a battery, and IGCC become commercialized, they will contribute environmental benefits—fossil fueled power production with low emissions. Such contributions can be realized even before Vision 21 is commercialized in the post-2110 timeframe.

Just as the CCT Program is a government-industry cost-shared program, Vision 21 is seen as a cost-shared, industry-driven program that will most likely require the efforts of teams composed of private companies working together. Government involvement is necessary not only to coordinate the work of participants, but also to help share the risks of technology development.

The energy industry is beginning to restructure itself. It is expected that the price of electricity will drop when competition begins in retail markets. Competition and restructuring, according to DOE's Fossil Energy Strategic Plan, will prompt industry to reduce longer term research, development, and demonstration (RD&D) investments "for... advanced, low-emission fossil fuel technologies," and focus on near term operational issues,

reinforcing the need for federal government participation.

Vision 21 stakeholders will represent a broad cross section of organizations vitally concerned about energy options, including industry, state governments, universities, laboratories, and other interest groups. 

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DOE Seeks Participants Who Will:

- Expand existing partnerships and linkages with industry, private and public R&D laboratories, and with other state and federal programs.
- Create technology options that are both technically and economically feasible, and identify approaches and products that have substantial market and profit potential.
- Identify and overcome barriers prohibiting the commercialization of Vision 21 plants, by helping develop enabling technologies or by exploiting new information and existing approaches.
- Develop a structured RD&D roadmap approach and schedule complete with decision points for meeting Vision 21 goals.
- Identify and prioritize needed resources to conduct the RD&D program.

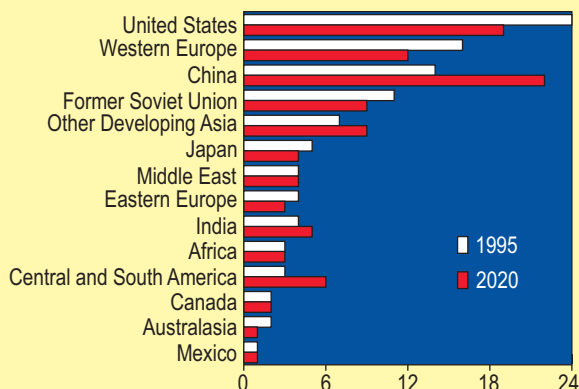


Coming to Agreement . . .

This excerpt summarizes a U.S. State Department fact sheet on the Kyoto Protocol, which was developed by the U.S. and more than 150 other nations at a conference in Kyoto, Japan, in December 1997. This protocol is designed to reduce greenhouse gas (GHG) emissions worldwide. We offer this summary as a service to our readers.

- *The historic Kyoto Protocol will reduce GHG emissions by harnessing the global marketplace to protect the environment.* The Protocol reflects several U.S. proposals for emissions targets and timetables for industrialized nations, and market-based measures for meeting those targets. The Protocol also makes a down payment on meaningful participation by developing countries.
- *The Protocol includes binding emissions targets for developed nations.* Limits vary—8 percent below 1990 emission levels for the European Union, 7 percent for the U.S., and 6 percent for Japan. For the U.S., the 7-percent target represents at most a 3-percent real reduction below President Clinton's initial proposal to reduce GHG to 1990 levels by 2008 to 2012. The remaining 4 percent results from changes in the way GHG gases and sinks are calculated. Altering the accounting method for carbon-absorbing activities, such as tree plantings, accounts for about 3 of the 7 percent reduction.
- *Emissions targets for all six greenhouse gases are to be reached over a 5-year U.S.-proposed budget period.* This increases flexibility by smoothing short-term fluctuations in weather and national economies. The first budget period is 2008 to 2012, allowing time to improve energy efficiency and technology.
- *Activities that absorb carbon, such as tree plantings, will be offset against emissions targets.* The role of forests is critical to a comprehensive, environmentally responsible approach to climate change. It also provides the private sector with low-cost opportunities to reduce emissions.
- *The Protocol includes emissions trading.* This free-market approach, pioneered in the U.S., allows countries to seek the cheapest emissions reductions. Countries or companies can purchase less-expensive emissions permits from countries that have more permits than they need (because they have met their targets with room to spare). Emissions trading can be a powerful economic incentive to cut emissions while allowing flexibility.

Regional Shares of World Carbon Emissions, 1995 and 2020



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